APPENDIX F-2

Qualitative Analysis Paper
Spatial and Temporal Management of Total Allowable Catch

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ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
BSAI	Bering Sea/Aleutian Islands
BSPRA	Bering Sea Pollock Restriction Area
CDQ	community development quota
CFR	Code of Federal Regulations
CVOA	Catcher Vessel Operational Area
DAP	domestic annual processor
DSR	Demersal Shelf Rockfish
EBS	eastern Bering Sea
FMP	Fishery Management Plan
GOA	Gulf of Alaska
GSO	General Service Office
IFQ	individual fishing quotas
ITAC	Interim Total Allowable Catch
JV	joint venture
LLP	License Limitation Program
MRB	maximum retainable bycatch
mt	metric tons
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
OFL	overfishing level
OY	optimum yield
PSC	prohibited species catch
SAFE	Stock Assessment and Fishery Evaluation
SCA	Steller sea lion Conservation Area
SEO	Southeast Outside District
SSC	Scientific and Statistical Committee
SSEO	South Southeast Outside District
TAC	total allowable catch

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Spatial and Temporal Management of Total Allowable Catch

1.0 Introduction

The spatial and temporal nature of the target fisheries in the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) is determined by a complex management structure which accounts for biological, socioeconomic, and conservation concerns. The term "spatial" refers to how fisheries are managed over a geographic area. The term "temporal" refers to the timing of fisheries over the course of a year. Total Allowable Catch (TAC) is managed by target species, and allocation of TAC ranges from year-round and area-wide to relatively small spatial and temporal scales. The vulnerability of the stocks to fishing pressure, the bycatch of non-target species, socioeconomic concerns, as well as the degree of available scientific information about an individual stock all play a role in determining the scale (e.g., broadly or minutely) at which the TAC for individual stocks are managed.

The fisheries and groundfish resources of the BSAI and GOA[1] form distinct management units. These two regions differ in their history of fishery development, bathymetry, oceanography, target species, and the composition of the commercial catch. While many species occur over a broader range than the GOA or BSAI regions, stocks of common species in the GOA and BSAI are believed to be different than in adjacent regions (NPFMC 2002b).

The measures authorized for management of groundfish in the BSAI and GOA under the approved Fishery Management Plans (FMP) fall into two categories: framework measures and conventional measures. Framework measures are ones which often require adjustment on an annual basis, such as the setting of the annual yield to fall with an Optimum Yield (OY) range. These types of measures are administratively designed to allow the North Pacific Fishery Management Council (NPFMC) to respond rapidly to biological or socioeconomic changes within a fishery without having to amend the plan. Conventional measures, on the other hand, are specifically in their application and can only be altered by a formal amendment to the plan. These measures include permits, reporting requirements, gear restrictions, and allocations. Most of the current measures which implement the spatial and temporal management of the BSAI and GOA groundfish fisheries are conventional measures implemented through amendments to the FMPs.

Spatial and temporal management of TAC has evolved over time through these FMP amendments as different issues have been resolved by the NPFMC that required modification of various fisheries. These issues range in breadth and scope but generally fall into two categories of rationale: economic concerns and biological/conservation concerns. Some economic grounds for managing TAC in space and time include reducing competition between fisheries, dispersing the fishery in time, and increasing the access to the fishery resources for specific communities. Many early actions by the Council specifically dealt with allocation issues between certain fleets, for example, to allocate between foreign and domestic fleets, and later between inshore and offshore fleets. Other actions were specifically to disperse the fishery in space and time both to control the symptoms of the race for fish as well as to decrease bycatch in certain areas, as exceeding bycatch limits results in the closure of a fishery prior to reaching the target fishery TAC.

[1]Excluding halibut which is managed by the IPHC.

Biological and conservation concerns drive other spatial and temporal management decisions. Often when information on the impact on a stock is unknown, a precautionary response is to manage on smaller spatial and temporal scales in order to avoid the potential for localized depletion. This is particularly true during spawning seasons. Pollock is one of the key prey species in the BSAI and GOA, and specific spatial and temporal measures in both regions are intended to disperse the pollock fishery in space and time in order to avoid the potential for impacts on the endangered Steller sea lion. Prohibited species catch (PSC) are also allocated in space and time in order to protect small, localized populations of prohibited species (e.g., salmon, herring, crab), and target fisheries are closed when these caps are exceeded (Table 1).

Table 1. Restrictions on the "Other Flatfish" Fishery from 1994 to 2002 in the BSAI Management Area.

Year	Dates	Bycatch Closure
1994	2/28 – 12/31 5/7 – 12/31 7/5 – 12/31	Red King crab cap (Zone 1 closed) Bairdi Tannner crab (Zone 2 closed) Annual halibut allowance
1995	2/21 – 3/30 4/17 – 7/1 8/1 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1996	2/26 – 4/1 4/13 – 7/1 7/31 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1997	2/20 – 4/1 4/12 – 7/1 7/25 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1998	3/5 – 3/20 4/21 – 7/1 8/16 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
1999	2/26 – 3/30 4/27 – 7/04 8/31 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
2000	3/4 – 3/31 4/30 – 7/03 8/25 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
2001	3/20 – 3/31 4/27 – 7/01 8/24 – 12/31	First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance
2002	2/22 – 12/31 3/1 – 3/31 4/20 – 6/29 7/29 – 12/31	Red King crab cap (Zone 1 closed) First seasonal halibut cap Second seasonal halibut cap Annual halibut allowance

Note that in 1994, the other flatfish category included flathead sole. Unless otherwise indicated, the closures were applied to the entire BSAI management area. Zone 1 consists of areas 508, 509, 512, and 516, whereas zone 2 consists of areas 513, 517, and 521.

Source: Spencer *et al.* 2002

Managing TAC in space and time requires an in-depth knowledge of each stock biology and migratory patterns, and the relative impact that fishing will have on the stock biology. Often the knowledge of biomass distribution and migratory patterns is inadequate and the relative impact of fishing on these stocks is often unknown. Unlike many of the other issues under discussion in this Programmatic SEIS, for spatial and temporal management, there is no specific policy objective that relates to our current management of TAC in space and time. The current management of TAC has evolved over time in response to changes in the fishery, both biologically and socioeconomically. Each action or amendment was intended to respond to a specific need, thus there was a specific individual objective to achieve for each subsequent change to the FMP. Thus, spatial and temporal effects are management outcomes, rather than being a policy goal or objective, per se. This will be discussed further in the sections regarding the FMP amendments; however, current management practices do not follow an overarching spatial and temporal management objective.

Our current management of TAC in space and time is a reflection of these combined amendments to the FMPs. In each amendment, spatial and temporal management of TAC is a tool by which specific objectives are intended to be achieved. Spatial and temporal management measures are implemented on a stock-by-stock basis according to concerns as they arise, not in accordance with an actual policy direction to manage in space and time. Similarly, across alternatives, while some measures change in the bookends of each alternative, these are measures which reflect a change in overall management policy but not a change according to a specific policy for spatial and temporal management of TAC. It is a management tool that is used to achieve often competing objectives and is thus not considered as a policy objective in and of itself.

The intent of this paper is to provide a broad overview of the current rationale behind the spatial and temporal management of TAC for target groundfish stocks in the BSAI and GOA FMPs. There will also be an examination of alternative measures for formalizing and expanding upon spatial temporal management of target stocks and the research and data needs which would be necessary in order to do so.

1.1 Regulatory Areas

Fishing areas correspond to the defined regulatory areas within the fishery management units. The BSAI is divided into 16 reporting areas (Figure 1), some of which are combined for TAC specification purposes. The Bering Sea subarea comprises all of the regulatory areas except the three Aleutian Island areas (543, 542, 541). The Bogoslof district is area 518. The eastern Bering Sea (EBS) as a regulatory region includes all of the regulatory areas in the Bering Sea region except for the Bogoslof District (area 518). The EBS is managed as a regulatory region separate from the Bering Sea region for EBS pollock. All other stocks, regardless of whether the stock is described as being in the EBS, are managed Bering Sea area-wide, indicating that the regulatory area incorporates all of the regions including area 518. The Aleutian Islands subarea is comprised of regulatory Area 541 (eastern Aleutian Islands), 542 (central Aleutian Islands), and 543 (western Aleutian Islands).

The GOA is divided into seven reporting areas (Figure 2): the western GOA is Area 610, the central GOA includes Areas 620 and 630, and the eastern GOA includes Areas 640 and 650. Area 640 is the West Yakutat District (WYAK) while area 650 is known as the East Yakutat/Southeast Outside District (EYAK/SEO). For demersal shelf rockfish (DSR) management only, area 650 is further subdivided into subareas: East Yakutat (EYAK), North Southeast Outside (NSEO), Central Southeast Outside (CSEO) and South Southeast Outside (SSEO). Area 649 are state waters in Prince William Sound, while Area 659 encompass state waters within southeast Alaska. The Shelikof Strait District is a specific sub-management district for GOA pollock only (Figure 3).

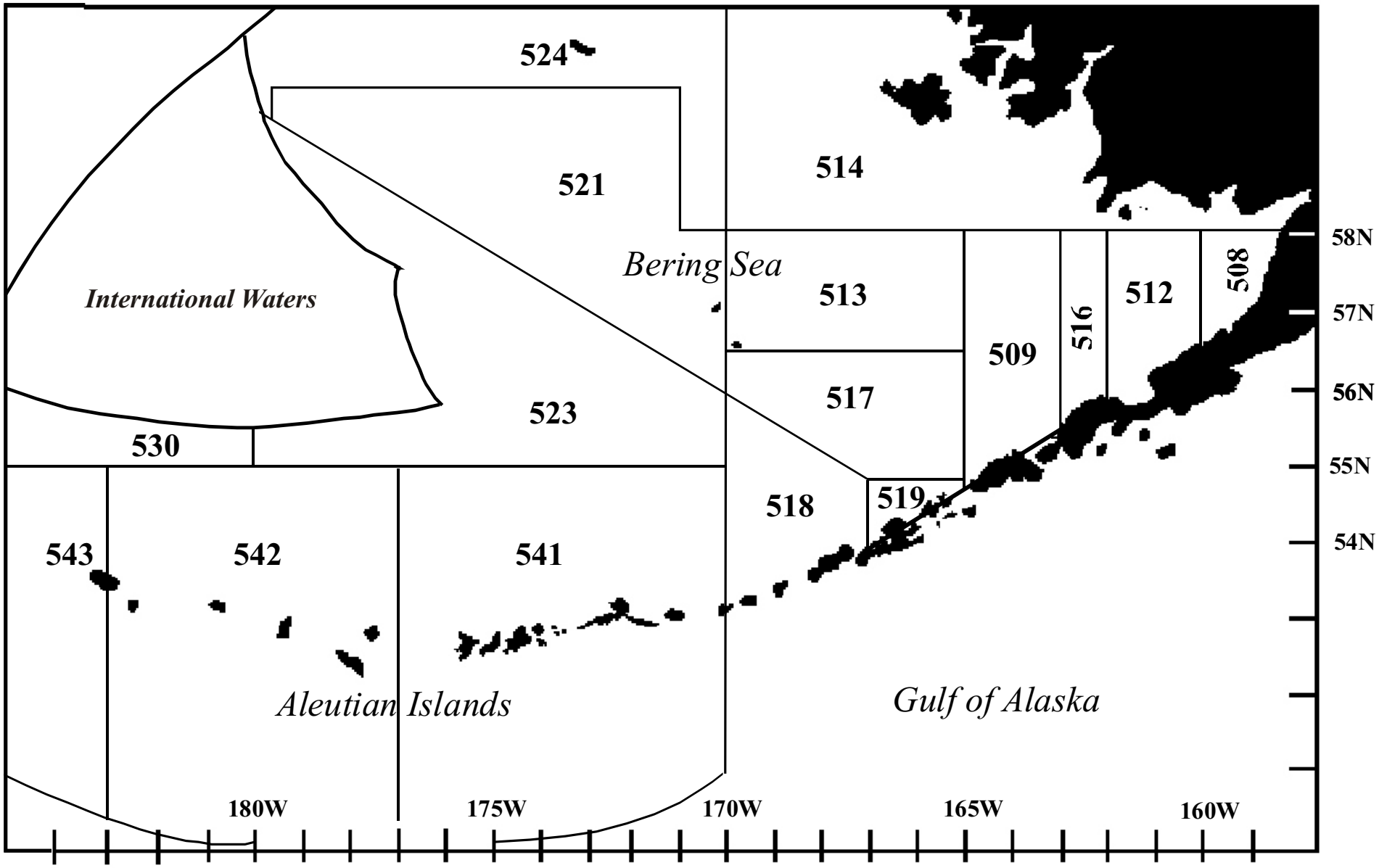


Figure 1. Bering Sea and Aleutian Islands Map of Regulatory Areas

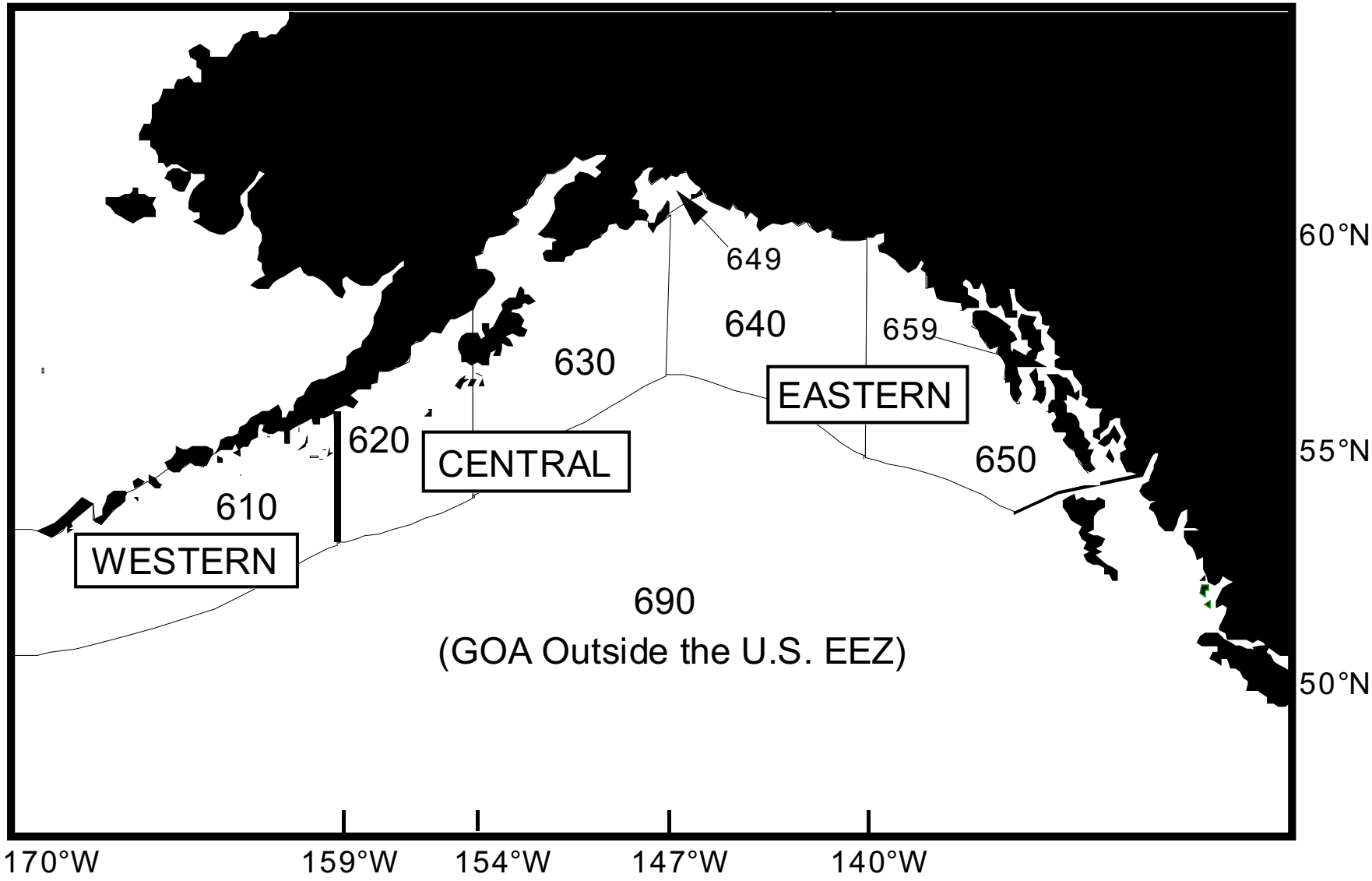
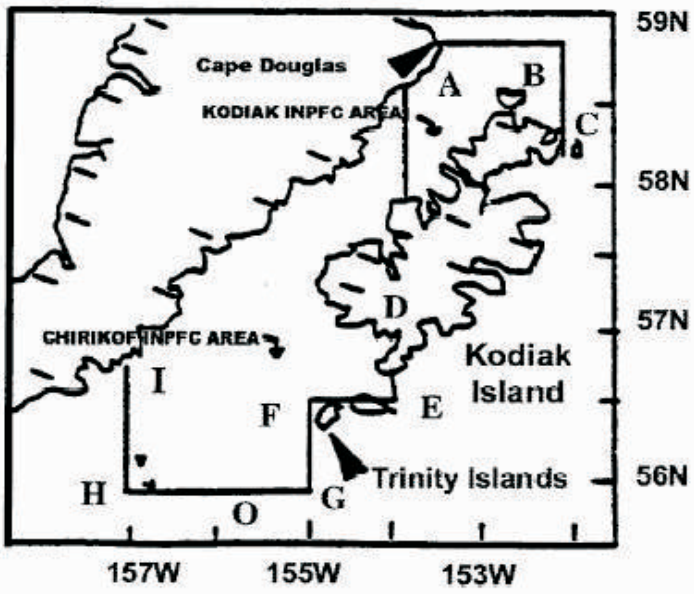


Figure 2. Gulf of Alaska Map of Regulatory Areas



Boundaries of the Shelikof Strait District in the Gulf of Alaska.

The Shelikof Strait District means all waters of the EEZ enclosed by a line connecting the following points in the order listed:

Reference point	N. Lat.	W. Long.	Description
A	58°51' N.	153°15' W.	Cape Douglas then
B	58°51' N.	152°00' W.	south to the intersection
C			of 152°00'W. with Afognak Island, then counter clockwise around the western shorelines of Afognak, Kodiak, and Raspberry Islands to
D	57°00' N.	154°00' W.	Alitak Bay then south to
E	56°30' N.	154°00' W.	then west through Trinity Islands to
F	56°30' N.	155°00' W.	then south to
G	56°00' N.	155°00' W.	then west to
H	56°00' N.	157°00' W.	then north to
I			Intersection of 157°00'W. with the Alaska Peninsula.

Figure 3. Shelikof Strait Regulatory Areas

Source: Gulf of Alaska Fishery Management Plan

1.2 Suballocation

Suballocations of TAC and PSC limits are made for biological and socioeconomic reasons according to percentage formulas established through FMP amendments. For particular target fisheries, TAC specifications are further allocated within regulatory areas (eastern, central, western Aleutian Islands; Bering Sea; western, central, and eastern GOA) among management programs (open access or community development quotas [CDQ] Program), processing components (inshore or offshore), specific gear types (trawl, non-trawl, hook-and-line, pot, jig), and seasons according to regulations 50 Code of Federal Regulations (CFR) 679.20, 50 CFR 679.23, and 50 CFR 679.31.

Suballocations of TAC to the various gear groups, management areas, and seasons are made according to regulation-driven formulas or, for discretionary allocations, according to Secretary of Commerce-approved specifications. The National Marine Fisheries Service (NMFS) uses in-season management authority to open and close the fisheries (50 CFR 679.25). The entire TAC amount is available to the domestic fishery (50 CFR 679.20). The gear authorized in the federally managed groundfish fisheries off Alaska includes trawl gear, fixed-gear, longline gear, pot gear, and non-trawl gear (50 CFR 679.2 Authorized Fishing Gear). TAC is allocated amongst these gear types, and specific allocation by gear types varies by target fishery and region.

1.3 Apportionment to Total Allowable Catch Reserves and Community Development Quota

TAC Reserves

A groundfish reserve is established at the beginning of each fishing year. This reserve amount of TAC is equal to the sum of 15 percent of each target species and the other species TAC in the BSAI Pacific cod, flounders and other species in the GOA. This TAC reserve is set aside by the NPFMC prior to the beginning of the fishing year. This reserve is used for: (NPFMC 2002a):

(a) unexpected expansion of the domestic fishery;
(b) correction of operational problems of the domestic and foreign fishing fleets, promoting full and efficient use of the groundfish resources;
©) adjustments of species TACs according to the condition of stocks during the fishing year; and
(d) apportionments.

This TAC reserve is not designated by species or species groups and will be apportioned to the fishery during the fishing year by the Regional Administrator of National Oceanic and Atmospheric Administration (NOAA) Fisheries (NPFMC 2002b). The Regional Administrator will determine the appropriate amounts and species for allocation, consistent with the most recent stock assessments of the individual resource conditions unless socioeconomic concerns and/or specific fishery operational problems are determined to dictate otherwise (NPFMC 2002b). The Regional Administrator may also withhold reserves for conservation reasons.

CDQ Allocation

Of the total TAC, the CDQ Program in the BSAI is allocated 10 percent of the allowable catch for pollock; 7.5 percent of all other groundfish, except 20 percent of fixed gear allocation for sablefish; and 7.5 percent

for prohibited species (50 CFR 679.31). The rest of the TAC is then apportioned to directed fishery or bycatch reserve according to spatial and temporal management measures that apply.

1.4 Harvest Specifications and Initial Total Allowable Catch Allocation

The fishing year coincides with the calendar year, January 1 to December 31 (50 CFR 679.2 and 679.23). Depending on the target species' spatial allocation (detailed below in the fisheries descriptions), additional specifications are made to particular seasons (quarters of the year or combinations of quarters) within the year. Fisheries are opened and closed by regulatory announcement. Closures are made when in-season information indicates the apportioned TAC or available PSC has been or will soon be reached, or at the end of the specified season if the particular TAC has not been taken (50 CFR 679.25).

Rules to establish harvest specifications are required for harvest in these federal groundfish fisheries to resume from one fishing year to the next. Specifying TAC and PSC limits follows the fishery regulation rulemaking process. To conform with rulemaking requirements, three separate rules are published per management area, per year. The published rules are, sequentially, 1) proposed specifications, 2) interim specifications, and 3) final specifications. This three-part process has been in place, with various refinements, since implementation of the FMPs. The process is explained in more detail below and in Appendix F-1, TAC-Setting Process qualitative assessment.

Proposed Specifications

Proposed acceptable biological catch (ABC), TAC, and PSC[2] specifications are typically recommended by the NPFMC at its October meeting and published in the *Federal Register* for public review and comment. The recommendations are based on the preliminary Stock Assessment and Fishery Evaluation (SAFE) reports prepared by the NPFMC's GOA and BSAI Plan Teams during and subsequent to their September meetings. Any new data on stock levels obtained from the previous summer's surveys are generally not yet in a useable form; therefore, the proposed specifications are based on previous year's data. At their 2002 September meeting, the plan teams recommended using a new approach for proposed specifications. This new approach used the 2001 SAFE Report model projections for 2003 preliminary and interim specifications for groundfish stocks at Tier 3 or above and to incorporate updated 2002 catch estimates rather than assuming that the catch is equal to the ABC as in previous years. This procedure is more in line with the intention to recommend preliminary and final specifications that most likely approximate the final specifications that will be recommended in November.

Occasionally, given evidence of imminent population changes, recent data may be used to recommend proposed specifications which may be different from the previous year's data. For example, in 2002, exploratory model results for GOA pollock using recent Shelikof survey data indicated a continuing decline of adult pollock. However, the model fit to the survey data at this time was poor and the model was unable to match the steep decline indicated by the survey results. While this was only a preliminary indication of stock decline, the stock assessment author was concerned regarding the stock status. At the October NPFMC meeting, the Scientific and Statistical Committee (SSC) concurred with the stock assessment author's

[2]BSAI crab and herring and GOA halibut only; BSAI PSC limits for halibut and salmon are established in regulations (50 CFR 679.21.)

recommendation and established the preliminary ABC as a rollover of the previous year's ABC for pollock. This represented a more conservative preliminary ABC than would have been recommended based upon the newly approved procedure in establishing preliminary ABCs. Preliminary SAFE reports are incorporated into the environmental analysis accompanying the proposed specifications rule.

Interim Specifications

Interim TAC specifications are mathematical determinations using the proposed specifications according to implementing regulations 50 CFR 679.20(c)(2). These regulations authorize one-fourth of each proposed Interim Total Allowable Catch (ITAC) and apportionment thereof, one-fourth of each PSC allowance, and the first seasonal allowance of GOA and BSAI pollock and BSAI Atka mackerel to be in effect on January 1 on an interim basis and to remain in effect until superceded by final specifications. NMFS publishes the interim specifications in the *Federal Register* as soon as practicable after the October NPFMC meeting. There are some exceptions to setting interim specifications in this manner. For instance, retention of sablefish with fixed gear is not currently authorized under interim specifications. Further, existing regulations do not provide for an interim specification for the CDQ non-trawl sablefish reserve or for an interim specification for sablefish managed under the individual fishing quota (IFQ) program.

While interim specifications are superceded by final specifications, depending on the stock, the interim specification can be used to specify the TAC for the first seasonal allocation. Depending upon the timing of final specifications and the fishery, the entire allotted TAC can be taken before the final specifications supercede the preliminary specifications. Thus, if preliminary specifications are set too high or too low, it can severely impact the fishery in the first season.

In the case of the 2002 GOA pollock, care was taken in recommending the preliminary specifications as if the stock showed an increased decline at the time of final specifications, with the regulatory system in place, the entire resulting Season A interim TAC could have been taken before the final TAC based on the most recent data that was in place. In some cases if the preliminary (and then interim) specification is too high compared to the final specification, this could result in the overfishing of a stock during the first seasonal allocation.

Final Specifications

Final TAC and PSC specifications are recommended by the NPFMC at its December meeting. The recommendations are based on SAFE reports prepared by the NPFMC's GOA and BSAI Groundfish Plan Teams during and subsequent to their November meetings. Final SAFE reports are incorporated into the environmental analysis accompanying the final rule (NMFS 2003a).

NOAA Fisheries packages the NPFMC recommendations into proposed or final rule specification documents and forwards them to the Secretary of Commerce for approval. Secretarial approval of final specifications usually occurs by March for the subject fishing year. Upon approval, the new TAC specifications replace the preliminary TAC specifications (50 CFR 679.20(c)(3)).

There is progress underway towards revising the TAC-setting process under Amendments 48/48. Under the current process there may be inadequate time allotted for the public to comment on the proposed specifications prior to the start of the fishery. Under consideration are alternatives to the current process publishing final specifications based on two-year stock projections, issuing specification every two years, and

changing the start of the fishing year from January to July. Additional proposed alternatives may also be considered depending upon a legal assessment of their adequacy in satisfying the requirements of Administrative Procedure Act. Final action on these amendments should be taken by the NPFMC in April or June, 2003.

1.5 In-Season Management

While TACs are established by the NPFMC based upon the best biological, ecological, and socioeconomic information available, circumstances arise on occasion whereby new information or data relating to stock status may become available and established harvest quotas or limits may need to be adjusted. These adjustments are accomplished by the NOAA Fisheries Regional Administrator in consultation with the agency's in-season management staff. Using all available information, the Regional Administrator may extend, open, or close fisheries in any or part of a regulatory area, or restrict the use of any type of fishing gear in order to conserve the resource. The Regional Administrator may also change any previously specific TAC or PSC limit if such are proven to be incorrectly specific on the basis of the best available scientific information on biological stock status (NPFMC 2002b).

In-season adjustments may be necessary to prevent either the overfishing of any species or stock of fish (including those for which PSC limits are set) or the harvest or closure of any groundfish TAC or PSC limit which may have been improperly specified (NPFMC 2002b). The Regional Administrator must first consider the least restrictive adjustments to the fishery in his or her choice of management responses to potential overfishing. The order in which the Regional Administrator must consider in-season adjustments to prevent over-fishing are specified as 1) any gear modification that would protect the species in need of conservation protection but which would still allow fisheries to continue for other species; 2) a time/area closure which would allow fisheries for other species to continue in non-critical areas and time periods; and 3) total closure of the management area and season (NPFMC 2002b).

1.6 Historical Summary of Major Fishery Management Plan Amendments Establishing Current Spatial/Temporal Management Measures

There is a long history of enacting measures for spatial and temporal management of TAC and gear and fishery allocations in the BSAI and GOA fisheries. The FMPs were instituted in 1978 and 1981, respectively, and both the original FMPs as well as many subsequent amendments have dealt sequentially with time and area restrictions as needs have arose. The following provides a brief list of many of these amendments, which were instituted to respond to a specific problem, and have subsequently evolved over time. This is not a comprehensive list of every amendment that had an allocative result, but synthesizes many (together with some additional regulations) which set the stage for the spatial and temporal management as it is currently pursued. The amendments are listed with their initial rationale as stated in their respective environmental impact analyses. An attempt is made to discuss first the BSAI amendments and then the GOA amendments. Although they are often discussed together in the FMPs, in some instances they are discussed as combined amendments in the text. The actual cumulative impacts of the amendments are not given here, only the intent of each individual amendment. More information on the cumulative impacts of these amendments may be found in Section 4.5.10 under Alternative 1. Most FMP amendments were multi-purpose in their intent, thus not all aspects of the amendments are discussed here. The emphasis is on the spatially and temporally relevant aspects of each amendment.

BSAI Amendment 11, implemented in 1987, enacted a split -season apportionment of joint venture (JV) pollock vessels. This amendment had both socioeconomic as well as conservation rationale behind it. This was an early amendment to the FMP to reduce the competitive disadvantage placed on domestic annual processors (DAP). This amendment also changed policy by prohibiting roe-stripping and reduced the concentration of the pollock harvest during the winter spawning season. While there was limited data at the time on the spawner-recruit relationship for pollock, there was a general consensus that prudent management by the NPFMC would require some limit on the harvests on spawning aggregations to alleviate the risk of reducing the stock's reproductive capacity. From an economic standpoint, it was more beneficial to the domestic industry to have exclusive access to the grounds during one month of spawning season. This amendment was limited to two years, in order for proper evaluation of the stock status and regime.

BSAI Amendment 12a, implemented in 1989, replaced Amendment 10 and revised the PSC limits for crab and halibut. Under this amendment, PSC limits were allocated among flatfish and other fisheries. Amendment 16 modified Amendment 12a by allowing for seasonal apportionments of the PSC caps, as well as by adding the DAP rock sole, DAP sablefish and turbot fisheries to those fisheries already managed under the PSC caps. This allowed for greater flexibility in managing bycatch more equitably and efficiently.

BSAI Amendment 13, implemented in 1990, allocated sablefish by gear type, dividing the TAC into fixed- and trawl-gear allocations for the Bering Sea (50/50) and Aleutian Islands (75/25). This amendment also established a procedure to set annual fishing seasons by regulatory amendment. The administrative aspect of this amendment was instituted to allow the NPFMC to respond more efficiently to an increasingly complex suite of management options that effect the timing of the various fisheries. In the GOA, this administrative procedure was established by Amendment 18. Amendment 13 also clarified the Secretary's authority to split or combine species groups within the target species management category by a framework procedure.

Amendment 14 to the BSAI FMP implemented in 1991, set forth a seasonal allowance schedule for pollock. While the impact of concentrated fishing on the stocks during spawning season was still unknown, it was deemed precautionary to mitigate against possible impacts by spreading out the pollock catch over a number of seasons. Pollock seasons were divided into roe-bearing and non roe-bearing seasons, with the percentage of the TAC allocated to each, determined during the annual TAC-specifications process.

BSAI Amendments 16a and 17, implemented in 1991 and 1992, respectively, again dealt with the BSAI pollock fishery. Amendment 16a specified the allocation of pollock TAC to bottom trawl in order to control crab and halibut bycatch. Amendment 17 established the Bogoslof subarea district (area 518) in order to allow for specific management of the pollock fishery in this region during the roe season. The Bogoslof area, the new reporting area 518, was established as the section of area 515 west of 167 West longitude in order to allow for a separate TAC for pollock in this smaller region. The remainder of area 515 was designated as the new area 519. This area does not have a separate TAC for pollock and is instead combined with the other reporting areas to make up the Bering Sea area for TAC allocation. The seasonal closures around the Walrus Islands were also permanently established under this amendment and occur from April 1-September 30.

BSAI Amendment 19, which supplemented Amendment 16, was implemented in 1992. This amendment, among other things, delayed the start of all trawl fisheries until January 20 with the exception of flatfish, which would begin May 1. This was done to address the high amounts of salmon bycatch and to address problems with bycatch in the pollock roe fishery as well as to reduce average bycatch rates for halibut. Also under this Amendment 19, allocations of PSC limits were respecified by more specific trawl fisheries and groups. This allowed for increased equity and accountability as the "other trawl" fisheries would also close

down when their limit was reached. Prior to that, only bottom trawl pollock and Pacific cod closed when the PSC limits were reached. Similarly, under BSAI Amendment 21, the Regional Administrator is authorized to apportion non-trawl PSC limits by specific fishery categories; to apportion them seasonally; and, to exempt some non-trawl fisheries from PSC limits when appropriate.

BSAI Amendment 24, implemented in 1994, established seasonal allocations for Pacific cod by trimester for longline and pot gear only. These seasons were January to May, June to August, and September to December. This helped to decrease the halibut bycatch mortality. Amendment 46 further decreased bycatch mortality by allocating Pacific cod across gear types.

BSAI Amendment 28, implemented in 1993, divided the Aleutian Island management area into three districts for spatially allocating TAC (Figure 1). These districts are east (area 541), central (area 542), and west (area 543). This spatial division of the Aleutian Islands into three districts allowed for harvesting of potential TAC for species exhibiting limited movement (i.e., Atka mackerel) while mitigating against the potential for localized depletion.

BSAI amendment 53, implemented in 1998, allocated shortraker/rougheye rockfish between the trawl and non-trawl gear sectors in the Aleutian Islands. Prior to this amendment, excessive bycatch of shortraker and rougheye in the Pacific Ocean perch and Atka mackerel trawl fisheries would close those fisheries.

In the GOA, the initial FMP established five statistical areas over which the OY was apportioned (Figure 4 Original 5 Areas). Under GOA Amendment 4, this was decreased to three in order to alleviate operational problems with maintaining these areas. These areas were named the western, central and eastern regulatory areas (Figure 2). Creation of the present day Southeast/East Yakutat District area and West Yakutat District area was accomplished through a combination of four subsequent amendments: Amendments 8, 11, 14, and 22. Under Amendment 8, the eastern GOA was subdivided into three different districts: Yakutat, Southeast Outside (outside 3 miles), Southeast Inside (inside 3 miles). This was done to prevent localized depletion of sablefish. This amendment also redistributed the other species category GOA-wide (from distribution over management areas due to insufficient data available for management at smaller spatial scales), and established a non-specified species category.

GOA Amendment 11 further subdivided the Yakutat District into East and West Yakutat District. This was done in order to better manage sablefish stocks by encouraging fishermen to extend their efforts over a wider area. Catch reporting in each district would enable more conservative management of local stocks. Under this amendment the area between 137° to 140°W longitude was called the East Yakutat District (area 68) and 140° to 147°W longitude is West Yakutat District.

GOA Amendment 14 defined a new regulatory district for better managing DSR (Figure 5). This new regulatory district was called CSEO district, located between 56°W longitude and 57° 30 minutes W longitude. Amendments 17/22 collectively established a separate statistical area around the area of Bogoslof Island in BSAI, established closures around the Walrus Islands in northern Bristol Bay in BSAI and rescinded GOA statistical area 68, East Yakutat District. Area 68 was not deemed necessary for fishery conservation and management and was therefore imposing unnecessary record keeping and recording costs. Practically NOAA Fisheries had been managing the two districts, East Yakutat and Southeast Outside as a single, combined district since 1984. In 1987, a single harvest quota was established for these combined districts (52 FR 785, January 9, 1987).

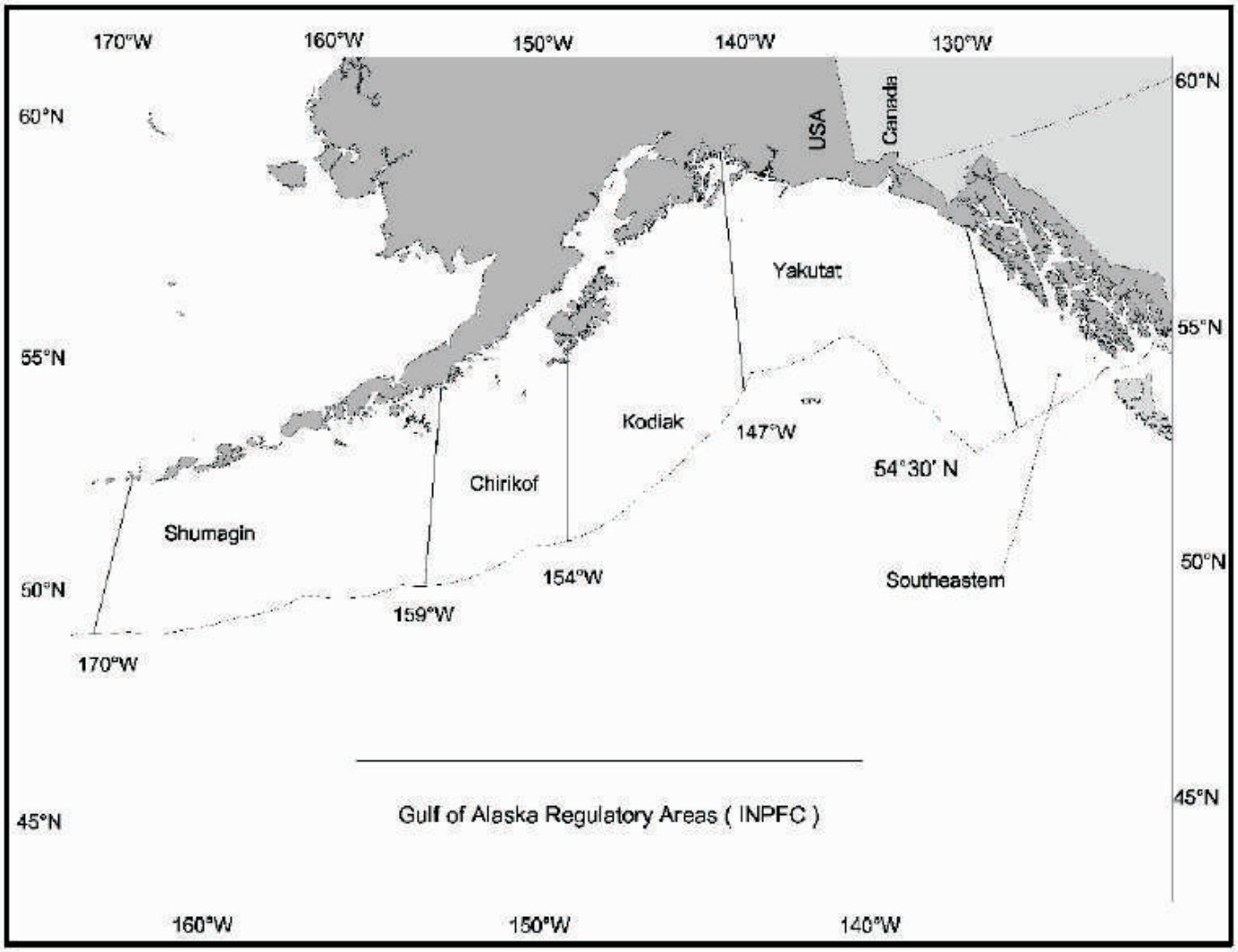


Figure 4. The Original Five GOA Management Areas

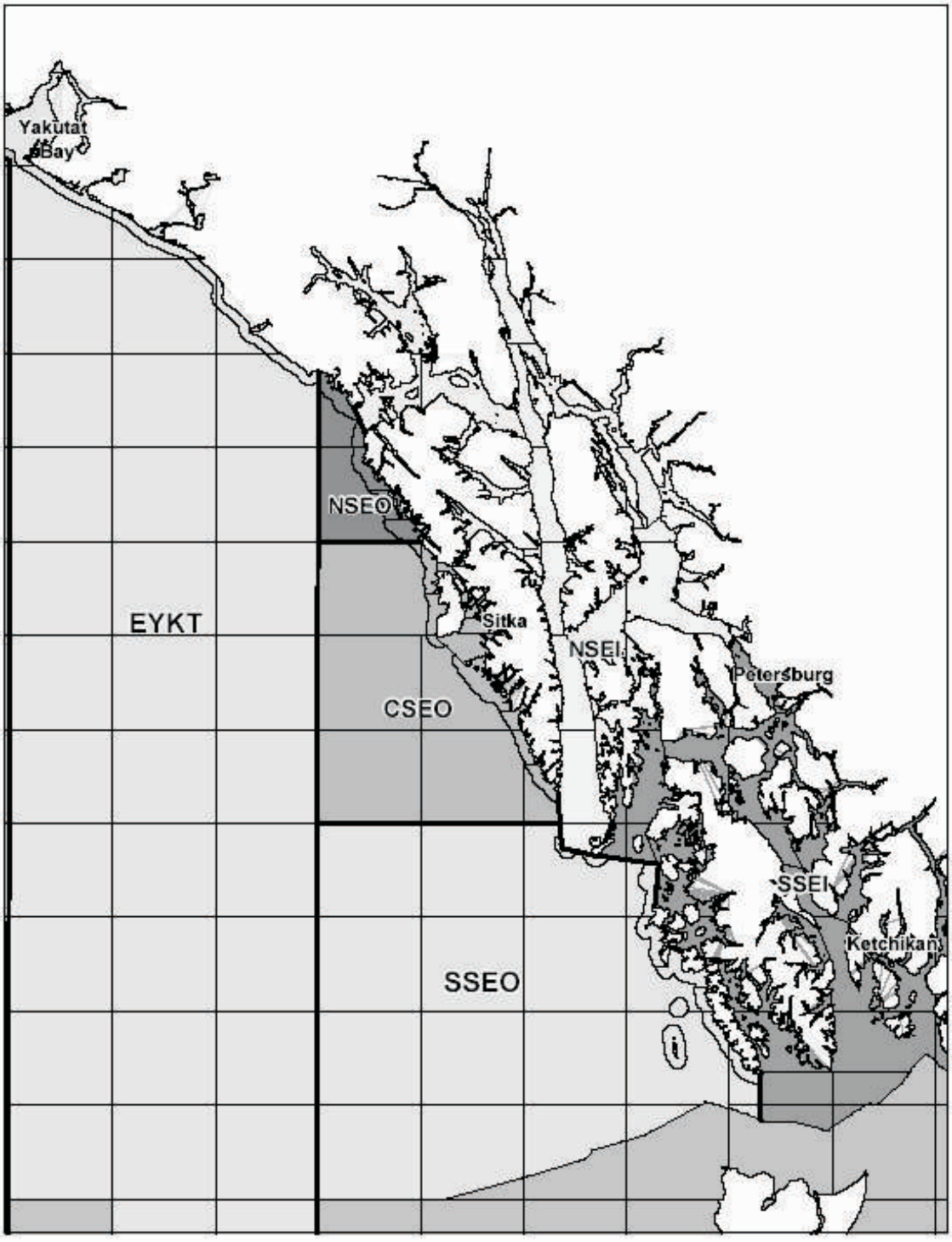


Figure 5. **The Alaska Department of Fish and Game and NOAA Groundfish Fisheries manage jointly areas EYKT, NSEO, CSEO, and SSEO sections , which comprise the Southeast Outside (SEO) Subdistrict. The NSEI and SSEI areas are managed entirely by ADF&G.**

Source: O'Connell *et al.* 2002

GOA Amendment 22 simply formalized this by rescinding area 68 and making East Yakutat and Southeast Outside a single, combined district for record keeping and recording purposes (Figure 5).

GOA Amendment 58 in 1998 prohibited trawling in the eastern GOA, in waters east of 140°W longitude. This trawl closure in the eastern GOA was instituted to preserve the small vessel fixed-gear fishery in this SEO region while the License Limitation Program (LLP) was being instituted in the GOA and BSAI. The closure also protects vulnerable rockfish stocks, which were seen to concentrate in this area. Due to this trawl closure, the ABC for northern rockfish in the eastern gulf is combined with that of other slope rockfish in the West Yakutat District.

Amendments 16/21 (BSAI 16/GOA 21) provide a range of changes to the FMPs including modified crab and halibut bycatch management measures in the BSAI as well as the establishment of interim groundfish specifications. Crab and halibut bycatch management measures established in Amendment 12a were modified by apportioning PSC caps to additional fisheries; DAP rock sole and DAP deepwater sablefish and turbot, apportioning PSC caps seasonally, and providing for the imposition of sanctions on vessels with excessively high bycatch rates. The seasonal apportionment of PSC caps exerts the most significant spatial and temporal measure here, as once seasonal allocations of PSC caps are reached, these fisheries can be closed. This is discussed further under Section 3.5.1 of the Programmatic SEIS. These amendments extend 25 percent of the proposed TAC specifications, made at the September meeting, into the new fishing year until superseded by publication of the final specifications. This process of interim specification has been described in Appendix F-1, TAC-Setting Process qualitative assessment.

Steller sea lion protection measures have been implemented in a variety of forms since 1992. Current measures were implemented by emergency rule in 2002, and by final rule in 2003, in order to avoid the likelihood that the groundfish fisheries off Alaska will jeopardize the continued existence of the western distinct population segment of Steller sea lions or adversely modify its critical habitat (FR January 2, 2003). These measures were implemented through regulations and thus are not amendments to the FMPs. There are several measures which pertain to the spatial and temporal management of groundfish fisheries in the BSAI and GOA, specifically with respect to the management of the prey species pollock, Pacific cod, and Atka mackerel. The measures with spatial and temporal TAC management aspects are discussed below, however, the full listing of all the protection measures, including all relevant closures, are discussed elsewhere in this document.

Spatial and temporal TAC management measures for Steller sea lion protection are implemented in the BSAI subareas and the GOA. In the Aleutian Island subarea, these measures include the apportionment of pollock to two seasons (40:60 percent to each), TAC apportionment by season and gear for Pacific cod, gear-specific area restrictions which alternate with the Atka mackerel fishery in critical habitat in waters west of 178°W. longitude, and a critical habitat harvest limit for Atka mackerel in waters west of 178°W longitude. In the Bering Sea, the measures include two seasons for pollock apportionment (40:60 percent in each), with an added restriction that no more than 28 percent of the TAC be taken from the Steller sea lion conservation area (SCA) before April 1, and Pacific cod TAC apportionments by season and gear. In the GOA, the measures include the apportionment of pollock evenly among four seasons and the apportionment of Pacific cod among two seasons (60:40 percent in each), as well as gear- and area-specific restrictions.

The combination of all of these and other amendments and regulatory changes sets the stage for the current management of TAC spatially and temporally. Many amendments build upon and modify previous ones. It is a complex system which also varies by region and by individual target species. Allocations and in-season

management decisions are based on the best available science; however, they are also limited in the amount and depth of data available.

1.7 Challenges in Seasonal Distribution and Apportionment of Target Species

Each year during the stock assessment process when the plan teams for the BSAI and GOA meet to discuss the status of individual stocks and make recommendations for future management, there are issues raised regarding the spatial and temporal distribution of different stocks. The decision-making process for how stocks are managed spatially and temporally is based both upon the level of biological concerns and information available as well as socioeconomic concerns. There are levels of decisions made within each stock assessment regarding the technique used to allocate stock biomass (e.g., average over five surveys or 5 years of surveys). These individual stock assessment decisions are based upon the range of assumptions made about stock viability, seasonal movement, spatial distribution annually and seasonally, and the statistical means used by each stock assessment author in addressing these issues. For a variety of reasons based upon availability of information, different species characteristics and individual author preference, stock assessment authors use different methods for estimating spatial distribution of stocks across management areas. Decisions are made based on the number of years of survey data available and recent catch information. The degree of averaging can also vary by the amount of information available to a stock assessment author, with more sophisticated means used as additional stock information becomes available.

Two examples are provided below of the challenges faced in spatially and temporally allocating TAC amongst management areas for two different stocks: GOA pollock and BSAI rockfish. These two examples provide insight into the management challenges faced by stock assessment scientists and fisheries managers in the spatial and temporal management of TAC. For GOA pollock, the concern lies with how to best approximate seasonal migration amongst areas in the absence of seasonally explicit spatial information. For the BSAI rockfish example, the concerns are whether or not to spatially allocate amongst smaller areas, and the inherent management and accounting problems inherent in doing so. Additionally, in the discussion of the current management of individual stocks (Section_ under Alternative 1) information is listed for the spatial/temporal allocation scheme for each stock assessment, with critical differences discussed as necessary.

GOA Pollock

GOA pollock is spatially apportioned amongst the regulatory areas: western, central, and eastern. The relative spatial allocation amongst areas is intended to approximate the relative proportion of the surveyed biomass in these regions. Since 1992, pollock TAC has also been seasonally apportioned in these areas in order to reduce impacts on Steller sea lion (Dorn *et al.* 2002). The TAC is apportioned spatially and temporally amongst these three management areas. Since 2001, four seasons were established to implement the Steller sea lion Protection Measures in the central and western GOA. These seasons begin on January 20, March 10, August 25, and October 1, with 25 percent of the total TAC allocated to each season. Both single species and ecosystem considerations provide the rationale for TAC apportioning, such that apportioning the TAC will spatially distribute the effects of fishing on other pollock consumers (i.e., Steller sea lions) and reduce the intensity of any adverse effects. Also, from a single-species perspective, TAC apportionment assures that no small component of the stock experiences higher mortality than any other (Dorn *et al.* 2002). While no sub-stock units have been identified yet in the GOA, it would be more precautionary to manage for their existence, thus if sub-units are identified, they are not subject to specifically

high mortality. This potential protection of sub-stock units is particularly important during the spawning season when they are spatially separated (Dorn *et al.* 2002).

The Steller sea lion Protection Measures are intended to apportion the pollock TAC based upon the seasonal distribution of biomass, and thus reduce the potential impact of fishing on these endangered sea lions. However, it is important to recognize that apportioning TAC based upon inaccurate or inappropriate estimates of biomass distribution could have adverse impacts both on the pollock population as well as on the species that prey upon pollock (Dorn *et al.* 2002). For this reason, consideration is paid to the apportionment scheme for all stocks and especially for spatial and temporal allocation of pollock.

Because pollock undergo an annual migration between summer foraging habitats and winter spawning grounds, the biomass distribution in each area will change seasonally. The apportionment scheme needs to reflect this. However, since surveying effort has been concentrated during the summer months and prior to spawning in late winter, the timing of this migration is not well understood (Dorn *et al.* 2002). There is extensive summer survey information, but limited winter survey information, with surveys concentrated primarily in the Shelikof Strait spawning grounds. Dorn *et al.* (2002) recommended an apportionment scheme that attempts to synthesize and best use the available limited information on the summer and winter pollock distributions and the timing of the migration to and from spawning areas.

Apportionment Scheme

This apportionment scheme uses a ternary plot to show the seasonal distribution of biomass and the distribution between areas for summer and winter (Figure 6). The ternary plot is then used to estimate the seasonal movement between areas. Relative biomass apportionment between areas 620 and 630 has been a particular problem, especially during the A Season. Previous recommendations were based on the assumption that the pollock stock on January 20 had the same spatial distribution as the mean distribution on the spawning grounds in mid-March. However, the experience of the fishing fleet since 2000 in these areas suggests that this is not accurate (Dorn *et al.* 2002).

Three alternative apportionment strategies were considered by Dorn et al. (2002), using relative percentages of biomass in each area from the summer distribution (Option A), the winter survey distribution (Option B), or the midpoint between summer and winter distribution (Option C). For all of these options, the distribution of biomass in area 610 remains the same (24.73 percent). This reflects the assumption that pollock targeted by the 610 fishery in the A season are fish that will spawn in 610 (Dorn *et al.* 2002). Under Option A, the relative distribution of biomass in areas 620 and 630 was 45.23 percent and 30.05 percent, respectively. This represents the distribution of biomass obtained in area 630 in the summer with 620 biomass obtained by subtraction. This distribution assumes that the migration between areas has not begun by the start of the A Season. The second option, Option B, results in relative apportionments between 630 and 620 of 66.46 percent and 8.81 percent, respectively, and assumed that the seasonal migration between areas has already been accomplished. This option is based on the relative winter distribution. Finally, Option C takes the midpoint of these two assumptions, giving a relative distribution of 55.84 percent in Area 620 and 19.43 percent in area 630. This midpoint graphically represents the assumption that the fish are moving from one area to another during season A, thus the relative distribution of biomass should reflect neither the exact summer nor winter distribution.

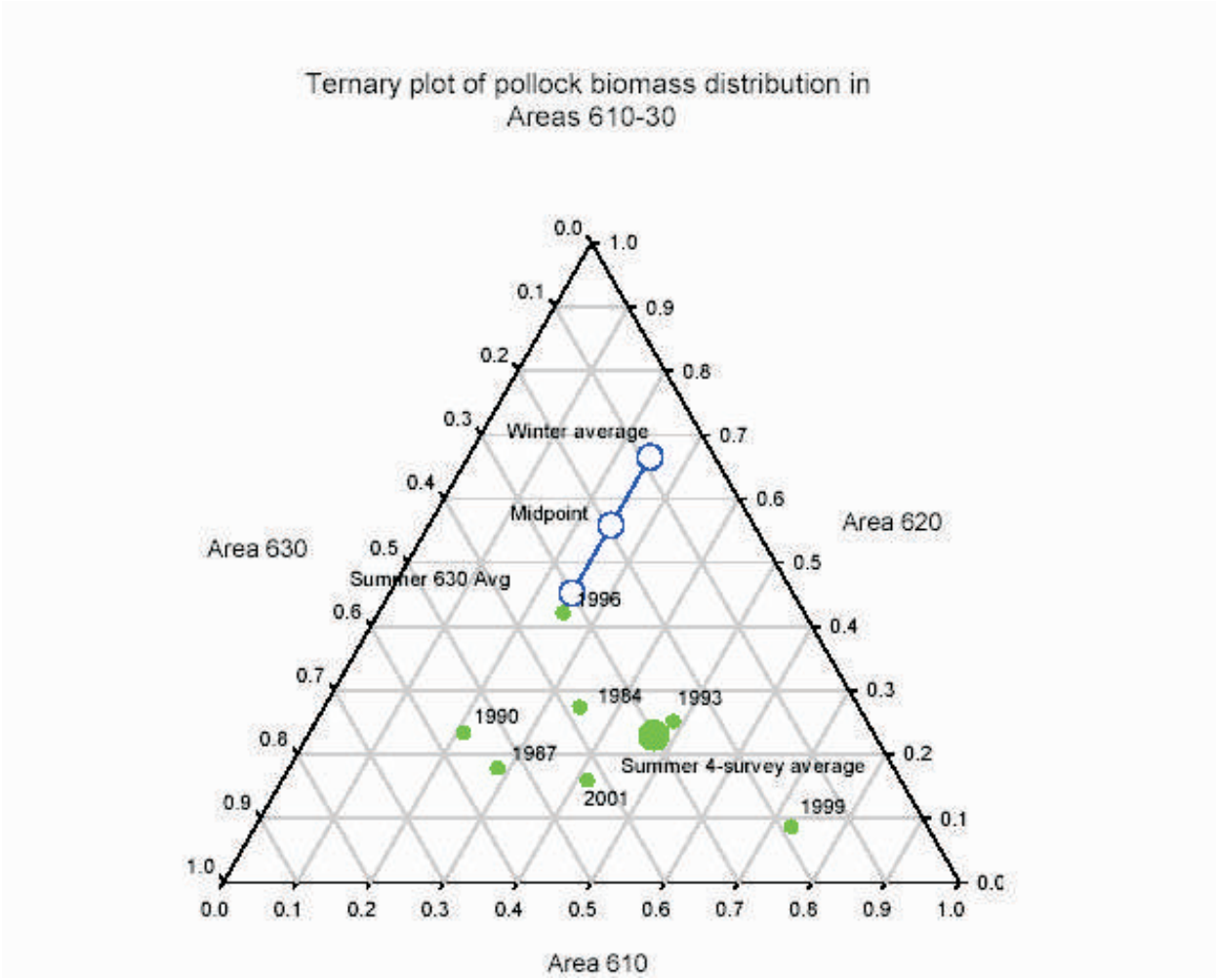


Figure 6. Ternary Plot of the Seasonal Biomass Distribution of Walleye Pollock in the GOA.

Source: Dorn *et al.* 2002

At their November 2002 meeting, the plan team recommended Option C for an apportionment strategy and the use of a 4-year unweighted average to compute the survey biomass. The plan team also concurred with the assessment author's recommendation that any overage or underage of pollock harvest at the end of the B season be proportionately subtracted from or added to the western/central management areas based on the estimated distribution of pollock in the C/D seasons. The plan team further recommended that data collection efforts be increased in order to utilize the data more effectively for the actual seasonal apportionments.

This example of the strategy utilized in the GOA pollock apportionment, and the importance of recognizing the limited data available to choose apportionment schemes highlights the inherent problems and trade-offs in spatially and temporally apportioning individual fisheries. For many fisheries data is lacking or insufficient to make decisions on seasonally spatial apportionment. As described above for GOA pollock, while some seasonal survey data is available, and thus innovative means are being used to extrapolate missing data, better data at specific seasonal migration times are necessary to validate the management schemes being utilized.

Otherwise, apportionment schemes may not reflect the actual seasonal biomass distribution, and seasonal TACs may be over or under harvested accordingly.

BSAI Rockfish Management

Rockfish are a slow-growing, long-lived species that are particularly vulnerable to over-exploitation and slow to recover once driven below the level of sustainable yield (Leaman and Beamish, 1984; Francis, 1985). Thus, rockfish management has been a continual concern for the NPFMC. Specific concerns regarding the management of the other red rockfish complex has been under review by the NPFMC since October 2002. The other red rockfish complex includes shortraker/rougheye rockfish and northern rockfish. Concerns which have been raised by the NPFMC regarding other red rockfish management include the reliable species identification within the shortraker/rougheye rockfish species group, the apportionment of this species group TAC among the Bering Sea subarea and the three Aleutian Islands subarea districts, and concerns regarding the overfishing level (OFL) and ABCs for northern rockfish by management area.

The Pacific ocean perch rockfish species complex has been continually changing as different species groups are moved into separate species categories and more information becomes available. Specifically, the other red rockfish complex currently contains shortraker/rougheye rockfish and northern rockfish after the movement of sharpchin rockfish to the other rockfish complex in 2002. These various movements of species from species complexes are designed to better protect the vulnerable rockfish stocks. Currently, separate TACs are established for the Bering Sea and Aleutian Islands management areas; however, the OFL pertains to the region as a whole.

It has been recommended by the BSAI Plan Team in both 2000 and 2001 that a single BSAI-wide ABC be applied for each species of the other red rockfish complex, partitioned by management area according to recent survey biomass estimates (Reuter and Spencer, 2002). While the NPFMC adopted this recommendation, it was hindered by the ability of observers to identify shortraker and rougheye rockfish to species level. The observer program in 2003 will implement a number of changes aimed at increasing the ability of observers to identify shortraker and rougheye rockfish to species level on longline vessels. Currently, shortraker/rougheye are still treated as a complex. Improvements in observer identification should allow single-species ABC determinations in the future.

Additional Shortraker/Rougheye Management Concerns

The OFL and ABC for shortraker/rougheye is established for the BSAI and TACs are applied to the two subareas. There have been concerns raised that the Aleutian subarea should be apportioned by individual regulatory area to prevent the possibility of localized depletion. In 1997, the ABC for shortraker/rougheye in the Aleutian Islands was caught. Thus, to prevent overfishing of the complex, special reporting requirements were implemented, some fisheries were closed and other groundfish catch foregone. The estimated catch in 1997 was only 207 metric tons (mt) less than the OFL of 1,250 mt. In 1998, the NPFMC recommended and NOAA Fisheries implemented a revision of the maximum retainable bycatch (MRB) of this complex. Shortraker/rougheye was separated as a species category for MRBs (previously it was managed under "other red rockfish") and retention was limited to 7 percent of deep water species and 2 percent of shallow water species.

Since October 2002, the NPFMC has been considering apportioning the shortraker/rougheye TAC in the Aleutian Islands subarea by individual districts, following public interest in this apportionment. The catch

in 2002 by subarea district did not show a disproportionate catch by subarea (NMFS, 2002). This may be because the primary targets for trawl gear (Atka mackerel and Pacific Ocean perch) are already apportioned by subarea in the Aleutians.

There are ramifications for management of apportioning the TACs by subareas in the Aleutian Islands for shortraker/rougheye. These problems include the potential change in the distribution of target species in the subareas and thus the chance for premature closures of these fisheries, and the increased complexity of inseason management measures on this smaller management scale (NMFS 2002). If the distribution of target fisheries or shortraker/rougheye abundance change significantly, the relative catch may also change in and among the subareas. This could result in the subarea-specific TAC being exceeded for shortraker/rougheye, requiring that this be treated as prohibited species status and that any future catch be discarded. Given the difficulties of managing species complexes that are caught incidentally on such a small scale may require that management prohibit retention of shortraker/rougheye on a preemptive basis rather than waiting on current inseason data.

Northern Rockfish Management

Northern rockfish have also been a concern for fisheries managers. Particularly, there are concerns regarding the reliability of stock biomass information for northern rockfish stocks in the EBS and Aleutian Islands. Unreliable biomass estimates can lead to under or overfishing of stocks by management area and trigger inseason management measures to close fisheries. Under Tier 5 management, the biomass estimates for the northern rockfish complex relies solely on survey biomass estimates. In December 2002, the SSC set the northern rockfish stock in the EBS in Tier 6 as a precautionary measure due to unreliable stock biomass estimates. This resulted in a higher ABC but a lower OFL by regulatory area than was recommended by the stock assessment authors. A lower OFL puts many Bering Sea fisheries at risk of premature closures should the OFL be exceeded. The NPFMC, following information presented by the Alaska Fisheries Science Center (AFSC) scientists as well as a report from the SSC, revised its 2003 northern rockfish TAC specifications by combining the BSAI ABCs and OFLs. More reliable information on northern rockfish biomass is necessary before this complex can be managed more effectively.

The difficulties with BSAI rockfish management are related to the uncertainty in biomass information for each stock. Some specific concerns with acquiring reliable biomass estimates include the problems encountered with trawl survey gear and the general design of these studies. There are two primary problems: one relates to the inadequate sampling of rockfish habitat, and the second to the disproportionate sampling of biomass. Rockfish habitat is particularly difficult for trawl gear to sample as it is rocky and often the bathymetry is too rugged for most gear. Thus, difficult areas are not sampled, and rockfish biomass in these regions may be underestimated. Rockfish can also be patchily distributed in particular habitat types, thus if a survey catches large concentrations of rockfish in habitats that constitute a small fraction of overall strata, then the area-swept estimate would overestimate biomass. Conversely if the trawl survey misses patches of rockfish then it will underestimate biomass. Disproportionate over-sampling and under-sampling of rockfish patches would be exacerbated by inadequate sample size leading to large interannual variability in estimated biomass levels. More information on these problems and some on-going work to improve surveying of rockfish can be found in the Discussion Paper on Rockfish Research and Management, by the Rockfish Working Group (NMFS, 2003b).

Spatial and temporal management of TAC is dependant upon the amount of available information on stock biomass and distribution. As mentioned in the sections above, the available data impacts management in a

variety of ways, from the necessity of making assumptions regarding seasonal migration between areas for GOA pollock, to the ability to apportion rockfish on smaller spatial scales. Accurate management on small spatial and temporal scales requires specific data on each individual stock. However, in the interest of precautionary management, apportionment decisions are made on the best available science and vary across each stock. As current management practices show, stocks are managed on different spatial and temporal scales depending upon their perceived vulnerability to overfishing, socioeconomic concerns within the fishery, and the availability of scientific information on the stock.

2.0 Analysis of Alternatives

The following four policy alternatives are under consideration by the NPFMC:

Alternative 1: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The approach would be to continue the current strategy which relies upon spatial and temporal management of stocks according to individual stock concerns as well as interactions with other species (i.e., Steller sea lions) on a stock-by-stock basis and in consideration of such additional factors as bycatch, socioeconomic concerns, scientific data availability, and an assessment of the vulnerability of individual stocks.

Alternative 2: A less precautionary management policy (i.e., more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known. There would be no change to the current spatial and temporal management practices. However, as PSC limits would be adjusted or eliminated under this alternative, the seasonal spatial and temporal management of target species would be impacted.

Alternative 3: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the "environment," not just a population of a given species. Under this alternative, objectives and criteria will be developed for allocating TAC in space and time. The spatial and temporal nature of some fisheries may be impacted by reducing PSC limits in the BSAI and GOA.

Alternative 4: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns. More emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment, but due to a lack of information and uncertainty, we

know little about these impacts. Under this alternative, TAC would be distributed on smaller spatial scales for all possible species. EBS pollock provides an example of how finer-scale spatial (and temporal) management might be approached. The spatial and temporal nature of some fisheries may also be impacted by the reduction in PSC limits in the BSAI and GOA.

3.0 Alternative 1: Continue Under the Current Risk Averse Management Policy

This alternative, as illustrated by the current BSAI and GOA FMPs, would maintain the existing spatial and temporal allocations of TAC for all stocks. Currently, there are no explicit objectives for managing TAC spatially and temporally. Rather, management varies according to the individual target stocks as well as the predators dependent upon these stocks (e.g., seabirds, Steller sea lions, and other marine mammals). Some stocks are managed at a single spatial and temporal level, while others are managed at a very fine spatial scale and have multiple seasons to disperse the fishery temporally. Generally, the ability to manage stocks at a fine spatial and temporal scale is dependant upon the biological concerns regarding the stock itself as well as the degree of scientific information available for the stock. Often decisions are made to change fishing seasons when targeting a certain stock may cause an unacceptable level of bycatch in another stock, thus, the temporal nature of the fishery is moved. The following is a description of how stocks are managed under the current system and a rationale for why certain stocks are managed on smaller spatial or temporal scales than others.

For all fisheries (unless otherwise noted), the fishing season for fixed gear runs from January 1 to December 31, and for trawl gear the season runs from January 20 to December 31. Many fisheries are further suballocated according to seasons, with the rationale for this suballocation varying according to the individual stocks. The spatial and temporal allocation schemes are listed for each stock below. If no temporal allocative scheme is listed specifically for the fishery, then this fishery is managed according to the fishing year only. Spatial allocative schemes often vary by individual stocks. Important differences in allocative schemes and the rationale thereof are noted.

3.1 Gulf of Alaska Management Area

The GOA is broken up into three management areas: eastern (E), central (C) and western (W) (Figure 2). These regions are broken into individual statistical and reporting areas. The western GOA is completely contained within Area 610. The central GOA is made up of areas 620 and 630. The eastern GOA contains two management areas, the West Yakutat District (Area 640) and the Southeast Outside District (650). Amendment 58 prohibits trawling eastern GOA east of 140°W longitude. Two new subareas were created by this amendment, West Yakutat (147° 140°W longitude) and East Yakutat/Southeast Outside (area east of 140°W longitude). Trawling is prohibited in the East Yakutat/Southeast Outside subarea.

3.2 Gulf of Alaska Stocks

The stock-by-stock description of spatial allocation schemes begins with stocks that are managed Gulf-wide and proceeds on progressively smaller spatial scales to those stocks managed with separate TACs for each regulatory area.

3.2.1 Stocks Managed Gulf-Wide

In the GOA, only Atka mackerel and the other species complex categories are managed Gulf-wide. This indicates that for these species a single OFL, ABC, and TAC are set for the entire gulf region.

Atka mackerel was separated from the other species category in 1994 through GOA Amendment 31. Since 1997, there is no directed fishery for Atka mackerel in the GOA. Instead, Atka mackerel's status has been bycatch-only. The stock population is low and believed to be vulnerable to fishing pressure due to its' patchy distribution and sporadic recruitment patterns (Lowe 2002).

In the GOA there are no reliable biomass estimates of other species and no annual stock assessment. The TAC is set at 5 percent of the total groundfish TAC and other species is managed as bycatch only.

3.2.2 Gulf of Alaska Stocks Managed in the Southeast Outside District

DSR is only managed (and fished) in the Southeast Outside District due to the amendments to the FMP as mentioned in the introductory sections and the restrictions on trawling from Amendment 58 to protect rockfish. For this stock, which the NPFMC has deferred management to the Alaska Department of Fish & Game (ADF&G), the Southeast Outside (SEO) District is further subdivided for DSR TAC into four smaller subareas: East Yakutat, North SEO, central SEO, and SSEO to prevent localized depletion (Figure 5). These areas are all part of SEO (Area 650). Southeast Inside (Area 659) are those state waters adjacent to Area 650. This area is managed by the state and is further subdivided into the north and south.

While the ABC for DSR is given for the SEO area-wide, this calculation is done by summing the individual ABCs by subarea (O'Connell *et al.* 2002). For DSR, 67 percent of directed fishery quota is allocated between January 1 and March 15, 33 percent between November 16 and December 31. Directed fishery quotas are set by management area and are based on the remaining ABC after subtracting for the estimated DSR bycatch in other fisheries. The bycatch limit of DSR during halibut fishing is equal to 10 percent of the halibut weight. The directed fishery in 2002 was pre-empted by the halibut fishery in East Yakutat subarea. The 2003 fishery is expected to be pre-empted by the halibut fishery again.

3.2.3 Gulf of Alaska Stocks which are Managed in Western, Central and Eastern Districts

Multiple stocks are managed spatially in western, central, and eastern districts: Pacific cod, Northern rockfish, Shortraker/rougheye and Thornyheads. Individual apportionment of ABC amongst areas varies by each individual stock.

For Pacific cod, the ABC is spatially allocated amongst areas according to a calculation of the average biomass distribution from the three most recent trawl surveys. The TAC area allocation is within 1 percent of this average biomass distribution on an area-by-area basis (Thompson 2002a). For 2003, the area allocation is western 39 percent, central 55 percent, and eastern 6 percent. Under measures implemented by the NPFMC to prevent potential competition with Steller sea lions, the TAC for the fishery is divided between the A Season and the B Season for the western and central regulatory areas. In these areas, 60 percent of the TAC will be allocated for the A Season, and the remaining 40 percent allocated for the B Season. Any Pacific cod harvested as bycatch between the closure of the A season and the opening of the B season is deducted from the B season apportionment.

For northern rockfish, the spatial apportionment of ABC among areas is by a weighted average based on survey biomass and relative variability in survey estimates/survey error. For 2003, this resulted in apportionment of 16.1 percent of the ABC in western area, 83.8 percent of the ABC in the central area, and 0.1 percent in the eastern area. The small eastern ABC for northern rockfish is combined with other slope rockfish in the WYAK for management purposes.

For shortraker/rougheye and Pacific ocean perch, the same method of apportionment is used as for Northern rockfish. In 2003, this resulted in an ABC apportionment for shortraker/rougheye of 13.3 percent of the ABC in the western GOA, 51.9 percent of the ABC in the central GOA, and 34.8 percent of the ABC in the eastern GOA.

For thornyhead rockfish, beginning in 2003, ABC will be apportioned by management area. Prior to this time it was managed Gulf-wide; however, given the historical concentration by foreign vessels in the central region (Ianelli and Ito 1995), the stock assessment authors were concerned that this pattern of concentration may reflect current trends as well (Gaichas and Ianelli 2002). Thus, the authors recommended management of thronyheads by region rather than Gulf-wide to avoid the potential for localized depletion due to concentration of the fishery. Observer coverage is not evenly distributed in this area thus it is impossible to determine the relative magnitude of removals in this region. Based upon the relative biomass in each area from four surveys (1990, 1993, 1996, and 1999), the relative apportionment of biomass by management area is as follows, western 18 percent, central 42 percent, and eastern 40 percent.

3.2.4 Gulf of Alaska Stocks Managed Spatially in Western, Central and East, Where the Eastern District is Further Subdivided into West Yakutat and East Yakutat/Southeast Outside

Stocks which are managed spatially in western, central, and eastern districts with the eastern district further subdivided into West Yakutat and East Yakutat/Southeast Outside include deep water flatfish, rex sole, shallow water flatfish, flathead sole, arrowtooth flounder, sablefish, other slope rockfish, Pacific ocean perch, and pelagic shelf rockfish.

Deep water flatfish are managed separately from shallow-water flatfish for purposes of differential halibut bycatch between the two fisheries. These fisheries are often closed quarterly as the halibut bycatch limit is approached (Table 1). Deep water flatfish and rex sole were closed in each quarter in 2002 (on May 24, August 2, and October 13, respectively) to prevent exceeding the halibut bycatch limit (Turnock *et al.* 2002). The shallow water flatfish fishery was closed May 15, August 5, and October 13 due to attainment of the halibut bycatch limit.

Rex sole was split out of the deep-water management category in 1993 due to concerns regarding the Pacific ocean perch bycatch in the rex sole target fishery (Turnock *et al.* 2002). Rex sole is now managed with a separate ABC.

The flathead sole apportionment was estimated by calculating the fraction of the 2001 survey biomass in each area and applying that fraction to the model-estimated ABC.

Arrowtooth flounder was separated from the flatfish assemblage by the NPFMC in 1990 for management purposes given its high abundance and low commercial value (Turnock *et al.* 2002). The recommended 2003 ABC apportionment by area of arrowtooth flounder is estimated by calculating the fraction of the 2001 survey biomass in each area and applying that fraction to the total ABC.

Sablefish apportionment is currently based upon 5-year exponential weighting of the survey and fishery abundance indices in weight by region. Prior to 2000 the ABC was apportioned based upon the survey data alone; however, since 2000 the NPFMC approved an allocative scheme based upon both survey and fishery data. Sablefish is allocated by gear type according to Amendment 14, whereby 80 percent of the quota is to hook-and-line gear and 20 percent to trawl gear in the western and central GOA. In the eastern GOA the quota is allocated 95 percent to hook-and-line gear and 5 percent to trawl gear. Amendment 8 to the GOA FMP established the West and East Yakutat management areas for sablefish. The sablefish fishery since 1995 is an IFQ fishery, and as such, is largely dispersed in space and time (Sigler *et al.* 2002).

In order to protect vulnerable stocks such as Pacific ocean perch, shortraker, rougheye and northern rockfish from possible overfishing, the NPFMC divided the slope rockfish assemblage in 1991(and again to separate northern rockfish in 1993) into management subgroups. Each subgroup, Pacific ocean perch, shortraker/rougheye, northern rockfish and other slope rockfish are assigned an individual ABC and TAC and apportioned amongst the three gulf management areas based on the distribution of exploitable biomass (Heifitz *et al.* 2002). Amendment 58 prohibited trawling in the eastern GOA area in waters east of 140°W longitude. Most slope rockfish are caught exclusively with trawl gear. In order to not concentrate fishing effort for rockfish between 140° and 147°W longitude, the NPFMC subdivided this area in 1999 into subareas (West Yakutat (between 147° and 140°W) and East Yakutat/Southeast Outside (east of 140°W) with separate ABCs and TACs assigned to these subareas for Pacific ocean perch and other slope rockfish subgroups (Heifitz *et al.* 2002)

The pelagic shelf rockfish assemblage is comprised of dusky, widow, and yellowtail rockfish. The ABC for dusky rockfish, widow and yellowtail rockfish are all computed separately and then summed for a Gulf-wide ABC for the entire assemblage. This ABC is then apportioned spatially by weighting the biomass according to the three most recent trawl surveys to compute biomass by area, yielding a percent distribution of approximately 9 percent in the western area, 63 percent in the central area, and 27 percent in the eastern area (Clausen *et al.* 2002).

3.2.5 Gulf of Alaska Stocks Managed Spatially in Western, with Central Subdivided Further into Area 620, Area 630 and Eastern Districts with East Subdivided into West Yakutat and East Yakutat/Southeast Outside

Pollock is the only fishery in the GOA which is managed with separate TACs by individual reporting areas in the central regulatory area (i.e., 620 and 630). Since 1992, GOA pollock has been apportioned spatially and temporally to reduce impacts on Steller sea lions (Dorn *et al.* 2002). The objective of the apportionment scheme is to allocate the TAC to management areas according to the relative distribution of the surveyed biomass. Four seasons were established in 2001 to implement the Steller sea lion Protection Measures in the central and western GOA. These seasons begin on January 20, March 10, August 25, and October 1 with 25 percent of the total TAC allocated to each season. Specific allocations amongst spatial areas (610, 620, and 630) are estimated according to the seasonal biomass distributions in these regions from the groundfish surveys. Information on the problems inherent in seasonally apportioning the gulf pollock fishery have already been discussed above. In the eastern regulatory area, pollock is not divided into seasonal allowances.

3.3 Bering Sea and Aleutian Island Stocks

The stock-by-stock description of spatial allocation schemes begins with stocks that are managed BSAI-wide and proceeds on progressively smaller spatial scales to those stocks managed with separate TACs for individual regulatory areas as specified.

3.3.1 Bering Sea/Aleutian Islands Stocks Managed Bering Sea/Aleutian Islands-Wide

The following stocks are managed BSAI-wide, indicating that the stock is managed as a single ABC, OFL and TAC between the BSAI area: Pacific cod, yellowfin sole, arrowtooth flounder, rock sole, flathead sole, Alaska plaice, other flatfish, squid, other species.

The Pacific cod fishery has been temporally dispersed across three seasons in 2001 and 2002, in an attempt to mitigate for possible impacts on Steller sea lions. These seasons are January through May, June through August and September through December (Thompson and Dorn 2002). Gear-specific TAC apportionments are established for these seasons and across all gear types. Bycatch of crab and halibut often cause the Pacific cod fisheries to close prior to reaching the TAC.

The yellowfin sole fishery is constrained seasonally by the PSC cap for the halibut fishery as well as the red king crab bycatch allowance. In 2002, the fishery was constrained twice for closures due to attainment of the halibut PSC cap (from May 11-21 and June 15-30) and Zone 1 was closed on May 21, 2002 for the remainder of the year to prevent exceeding the 2002 bycatch allowance for red king crab in the yellowfin sole target fishery (Wilderbuer and Nichol 2002).

The rock sole fishery in the BSAI is also closed periodically due to bycatch restrictions. In 2002, Zone 1 was closed from 2/22 to 12/31 due to exceeding the red king crab cap. The BSAI was closed for the following time periods after exceeding the first two seasonal halibut caps and the annual halibut allowance, respectively: March 1 through April 4, April 20 through July 1, July 29 through December 31 (Wilderbuer and Walters 2002).

Flathead sole was contained in the other flatfish assemblage prior to 1994. After this time it was separated out of that assemblage and assigned its own ABC, in order to comply with a request by the NPFMC and to comply with the change in the directed fishing standards to allow for increased retention of flatfish (Spencer *et al.* 2002).

Prior to 2002, Alaska plaice was managed as part of the Other Flatfish complex. Starting in 2002, it is being managed separately under its own ABC and TAC. Like the yellowfin sole and rock sole fisheries, the Alaska plaice fishery and the other flatfish fishery have also been closed due to the bycatch of halibut and a portion of the EBS has been closed in 2002 due to exceeding the red king crab bycatch allowance (Spencer *et al.* 2002).

The other species complex in the BSAI is currently managed based on Tier 6 criteria. Since 1999, discussions with the Plan Teams, SSC, and NPFMC have focused on better management of the other species complex. Separate ABC estimates have been proposed for squid and the remaining other species complex. Currently, the ABC for other species is managed as a single ABC for the whole complex.

3.3.2 Bering Sea/Aleutian Islands Stocks Managed in the Aleutian Islands only (Aleutian Islands Split by Eastern, Central, Western)

Atka mackerel is the only stock which is managed in the Aleutian Islands only, with the Aleutian Islands management split by eastern, central, western regulatory areas. Amendment 28 to the BSAI FMP divided the Aleutian subarea into three districts at 177°W longitude and 177°E longitude to spatially apportion TAC (Figure 1). Since 1994, BSAI Atka mackerel has been allocated to these three regions based on the four survey-weighted average of the biomass distribution from the Aleutian Island bottom trawl surveys.

Measures are currently in place to disperse the fishery temporally and spatially to reduce the level of fishing for Atka mackerel within Steller sea lion critical habitat. Temporally, the TAC is divided into two seasons. The A season runs from January 1 to April 15, and the B Season runs from September 1 to November 1.

Spatially the fishery is further dispersed by regulations regarding maximum catch percentages of each of these seasonal allowances which can be caught within sea lion critical habitat in the central and western Aleutian Islands areas. There are no critical habitat closures established for the eastern subarea, although year-round 20-nautical mile trawl exclusion zones exist around Seguam and Agligadak rookeries. The percent distribution for 2002 TAC inside and outside critical habitat was 40 percent inside critical habitat, 60 percent outside for both western and central Aleutian Island regulatory areas (543 and 542, respectively).

3.3.3 Bering Sea/Aleutian Islands Stocks Managed with Spatial Split between the Bering Sea and Aleutian Islands

Stocks managed with a spatial split between the BSAI include: Greenland turbot (TAC only, no ABC split), northern rockfish, shortraker/rougheye, sablefish, and other rockfish.

Greenland turbot: The ABC for Greenland turbot is split between Aleutian Islands and Bering Sea regions according to survey biomass estimates in both regions.

Sablefish is allocated by gear type, according to Amendment 13, with 50 percent allocated to fixed gear and 50 percent to trawl gear in the EBS, and 75 percent to fixed gear and 25 percent to trawl gear in the Aleutian Islands. Amendment 15 of the BSAI FMP (amendment 20 to the GOA FMP) established IFQ management for sablefish beginning in 1995. Under these amendments, 20 percent of the fixed gear allocation was allocated to a CDQ reserve for the BSAI. Sablefish is allocated by area based upon a weighted average using survey and fishery information.

Northern rockfish and shortraker/rougheye rockfish are assessed together as other red rockfish complex. Separate ABCs are established for northern rockfish and shortraker/rougeye by Bering Sea and Aleutian Islands management areas in proportion to recent survey biomass estimates. However, the OFL for each of these is for the entire BSAI combined area. This has been discussed previously in the section on BSAI other red rockfish management.

Other Rockfish

The other rockfish category is made up of 29 species, of which light dusky rockfish and shortspine thonyheads are the most abundant (Reuter and Spencer 2002). Sharpchin rockfish were moved into the other rockfish category in 2002. A separate ABC and OFL are set for the BSAI region. Concern was expressed

by the SSC in 2001 regarding disproportionate exploitation of any one of the species in the other rockfish complex (Reuter and Spencer 2002). Light dusky rockfish are the predominate catch in the Aleutian Islands, despite the fact that 85 percent of the other rockfish biomass is shortspine thronyheads. The stock assessment author recommended that light dusky rockfish be split out from the other rockfish in ABC and OFL determinations (Reuter and Spencer 2002). Data on the spatial distribution of light dusky rockfish indicate that it may be a single stock in the BSAI region (Reuter and Spencer 2002). It was therefore recommended that a combined biomass estimate be used in the BSAI for this stock, and a subsequent ABC and OFL be determined for the combined BSAI management area (Reuter and Spencer 2002). The NPFMC did not separate light dusky rockfish at this time; thus it continues to remain within the other rockfish complex and is managed spatially between the Bering Sea and Aleutian Islands regions.

3.3.4 Bering Sea/Aleutian Islands Stocks Managed between Bering Sea and Aleutian Islands (with Aleutian Islands split Eastern, Central, Western)

Pacific ocean perch is the only stock managed between the BSAI, with the Aleutian Islands split into three regulatory units, (eastern, central, western). Pacific ocean perch and four other species of rockfish (northern, shortraker, rougheye and sharpchin) were managed as a complex, the Pacific ocean perch complex, until 1991. In 1991 the NPFMC separated Pacific ocean perch from the complex in order to provide protection from possible overfishing (Spencer and Ianelli 2002). For the EBS slope region, the Pacific ocean perch complex was divided into two subgroups: Pacific ocean perch, and an "other red rockfish" category made up of shortraker, rougheye, sharpchin and northern rockfish. In 2001, the other red rockfish in the Bering Sea was further subdivided into two additional subgroups, rougheye/shortraker and rougheye/northern. In 2002, sharpchin was assigned to the other rockfish category. In the Aleutian Islands regions, the Pacific ocean perch complex was divided into three groups: 1) Pacific ocean perch, 2) shortraker/rougheye, and 3) sharpchin/northern (Spencer *et al.* 2001). Each of these subgroups is assigned an individual ABC and TAC.

Since 2001, the BSAI area Pacific ocean perch stocks have been assessed and managed as a single stock; however, a separate ABC is established after the stock assessment calculations for each area. While age-structured models for both Aleutian Islands and Bering Sea stocks were being done prior to 2001, there were concerns regarding the lack of data upon which to base an age-structured assessment as well as the uncertainty that the Bering Sea Pacific ocean perch represent a discrete stock (Spencer and Ianelli, 2001). The ABC for BSAI Pacific ocean perch is then split between the two management areas according to the percent of the combined biomass from surveys in both the Aleutian Islands and the EBS. For 2002, 16 percent of the ABC was allocated to the EBS region, while 84 percent was allocated to the Aleutian Islands region. The Aleutian Islands region is further partitioned amongst the Aleutian Islands management areas (E,C,W) according to the relative proportion of the estimated biomass from the five most recent trawl surveys.

3.3.5 Bering Sea/Aleutian Islands Stocks Managed with Bering Sea Split Out between Eastern Bering Sea and Bogoslof Regions, and Aleutian Islands (Managed Aleutian Islands-Wide)

Pollock is the only stock where the Bogoslof Region (area 518) is given a separate TAC for management purposes. The remainder of the Bering Sea regulatory areas are then combined into an area called the EBS for management purposes.

The BSAI pollock comprises three stocks for management purposes: the EBS, which consists of pollock occurring on the EBS shelf from Unimak Pass to the U.S.-Russia convention line; the Aleutian Islands regions encompassing the Aleutian Islands shelf region from 170°W longitude to the U.S.-Russia convention

line; and the central Bering Sea-Bogoslof Island pollock (Ianelli *et al.* 2002). These three regions, EBS, Aleutian Islands, and Bogoslof, are given individual ABCs and OFLs. The Bogoslof region has been closed to directed pollock fishing since 1992 to rebuild stock.

In order to reduce the potential for competitive interactions with Steller sea lion, measures have been taken by the NPFMC and NOAA Fisheries to disperse the pollock fishery in space and time according to pollock biomass distributions. These measures included the closures of additional areas around sea lion rookery or haulout sites (see Steller sea lion paper for more details on closures) as well as TAC-specific reductions and temporal allocations. In 2000, the entire Aleutian Islands region was closed to pollock fishing, and phased-in reductions in the proportion of seasonal TAC within the SCA were instituted. The pollock fishery is prosecuted under two seasons, the A Season beginning January 20 to April 15 and the B season beginning September 1 and running until November. The A Season is apportioned 40 percent of the TAC and the B Season is apportioned 60 percent of the TAC. Regulations further state that no more than 28 percent of the the annual directed fishery allowance be taken from the SCA before April 1 (FR notice January 2, 2003). Other allocative measures in the Bering Sea include the establishment of the Bering Sea Pollock Restriction Area (BSPRA) during the A Season, and the closure of the Catcher Vessel Operation Area (CVOA) to non-CDQ pollock trawl catcher/processor during the B Season (FR notice January 2, 2003). These last two measures are discussed in more detail in Appendix F-4, Steller Sea Lion qualitative assessment paper.

4.0 Alternative 2: Adopt a More Aggressive Management Policy

Under this alternative there are no proposed changes to the spatial and temporal management of TAC from the current FMP. As discussed previously, there are no specific policy objectives relating to spatial and temporal management, thus any changes from one alternative to the next would be within the tools listed in the individual bookend frameworks. All TAC allocations and spatial and temporal management would remain as described above for Alternative 1 (FMPs). However other aspects of this alternative may have an impact upon the temporal nature of some target stocks.

Spatial and temporal management changes under the FMP 2.1 and 2.1 bookends:

FMP 2.1: No change from Alternative 1
FMP 2.1: No change from Alternative 1

Additional measures which may have a related impact on spatial and temporal management of the fisheries are discussed below:

Specifically, under the framework for FMP 2.1, PSC limits are eliminated. Many fisheries are currently timed to avoid excessive bycatch in prohibited and non-target species, specifically many flatfish fisheries (Table 1). The fisheries close for periods of the years over different seasons when they have exceeded their PSC caps, usually for halibut bycatch (Table 1). Consequently, many of these fisheries do not catch their allotted TAC since they are closed for halibut bycatch reasons prior to reaching their TAC. Eliminating these PSC limits would mean that many of these fisheries would remain open for the whole season until their allotted TACs are achieved.

Another measure under FMP 2.1 which would impact spatial and temporal management of TAC would be the impact of repealing the sablefish IFQ and the CDQs (except for pollock and crab as mandated under the

American Fisheries Act). Repealing these programs from a TAC perspective frees up an additional 7.5 percent of the TAC for the directed fishery.

5.0 Alternative 3: Adopt a More Precautionary Management Policy

Under this alternative, there are no specific management policies that would change for spatial and temporal management. Under the FMP bookend 3.2, however, objectives and criteria by which to specifically allocate TAC in space and time would be developed. This would represent a departure from our current program. TAC is allocated spatially and temporally under Alternative 1. Under FMP 3.2, goals and objectives for allocating TAC in space and time would be developed, along with a sample uniform allocative scheme. There are also related measures within this alternative that would impact the spatial and temporal management of the individual fisheries. These related measures are the impact of fishery-specific TACs; breaking sharks and skates (and additional species) from the other species complex; reduced PSC limits on herring, crab, halibut and salmon; and establishing PSC limits in the GOA. While none of these measures directly change the spatial and temporal management of TAC they could all impact the nature of the spatial and temporal management.

Specific spatial and temporal management measures under the FMP bookends 3.1 and 3.2:

FMP 3.1: No changes from Alternative 1
FMP 3.2: Develop goals and objectives for allocating TAC in space and time.

In order to allocate TAC in space and time, specific goals and objectives for spatial and temporal management need to be developed. As previously explained, spatial and temporal allocation of TAC is a tool by which other objectives are achieved. There are currently no policies which denote the specific objective to manage on smaller spatial and temporal scale for the explicit benefit of the target fishery. Under FMP 3.2, however, it is assumed that a general overarching goal is to manage stocks on smaller spatial and temporal scales. In addition to explicitly declaring this policy objective, reasonable mechanisms must be developed to both systematically manage stocks in time and space, as well as to account for the varying degrees of uncertainty in stock biomass information across all stocks. This mechanism would need to be adaptive to the level of available information for each stock.

Proposed Season and Area Proportionate Harvesting Scheme

A proposed means of seasonal and spatial allocation is provided by G. Thompson (Appendix A *Grant's P cod allocative scheme*) This allocative scheme was initially developed for Pacific cod but is here made applicable to all stocks.

In order to allocate TAC on the basis of time and space, it is necessary to partition the fishing year and area. For example, the year could be partitioned into a number of seasons, and the area could be partitioned into a number of subareas. The seasons could be of equal or different lengths, the subareas could be of equal or different sizes, and the numbers of seasons and subareas could be equal or different.

In current stock assessments, biomass estimates are typically available only on a start-of-year and area-wide basis (for example, in the case of an EBS stock, we typically have estimates of January biomass for the entire EBS, but we typically do not have estimates of August biomass for area 517). However, as assessment

methodology continues to become more sophisticated, it is likely that season- and subarea-specific biomass estimates will become available for some stocks. When such estimates are available, they could form the basis for season-and-subarea-specific TACs. Such an allocation could be developed by first specifying the fishing mortality rate corresponding to the overall TAC. Then, this fishing mortality rate could be applied to each season-and-subarea specific biomass estimate to produce an "equal exploitation" distribution of season- and subarea specific TACs which would sum to the overall TAC. Then, a limit on the acceptable deviation from this distribution could be specified. For example, it might be determined that the catch taken from any single season- and subarea-specific cell could not exceed 150 percent of the value from the "equal exploitation" distribution (the 150 percent figure is purely hypothetical). Of course, the overall TAC could still be viewed as a constraint on the overall catch.

When season-and-subarea-specific biomass estimates are not available, something else would have to be used. One possibility would be to use the distributions of season lengths and subarea sizes to approximate an "equal exploitation" distribution of season- and subarea-specific TACs. The seasons could be expressed as proportions of the year, so they would sum to one. Likewise, the subareas could be expressed as proportions of the area, so they would sum to one as well. A subarea-by-season matrix R could then be formed in which rows represent subareas, columns represent seasons, and each element of the matrix is equal to the product of proportional subarea size and proportional season length, so the elements of R would sum to one. Then, the "equal exploitation" distribution could be approximated simply as the product of R and the overall TAC. As in the case where season-and-subarea-specific biomass estimates are available, a limit on the acceptable deviation from the "equal exploitation" distribution could be specified, and the method would proceed in the same way.

A variant on the above approach would be to form the "equal exploitation" distribution on the basis of the fishing mortality rate corresponding to ABC or OFL, rather than TAC. That is, an "equal exploitation" distribution of season-and-subarea-specific ABCs or OFLs could be formed, and acceptable deviations could be calculated relative to that distribution. Of course, the overall TAC could still be viewed as a constraint on the overall catch. In this approach, as with other allocative schemes, more specific biomass estimates on smaller, subarea scales by season would improve these season- and subarea-specific allocations.

Additional measures which may have a related impact on spatial and temporal management of the fisheries follow:

- Under the FMP 3.2, there are proposed changes to the TAC-setting process which may impact spatial/temporal management. The establishment of biological reference points based upon species-specific production patterns, using F_{60} as a proxy for vulnerable species is proposed under FMP 3.2. Under this alternative, TACs will be less for these vulnerable species and thus the fishery may close sooner and/or impact the timing of other fisheries which catch this as bycatch.

- Under Alternative 3 for TAC setting, both FMP 3.1 and 3.2 bookends examine ways to break a species out of a species complex. FMP 3.1 proposes to separate sharks and skates from the other species groups. FMP 3.2 proposes to separate sharks and skates and additional groups out of the other species groups. These changes would impact how the other species TAC for each of these measures is then calculated. Currently, the other species TAC is calculated as a percentage of the total TAC for all target species in the GOA. In the BSAI, the other species ABC is calculated as a Tier 6 stock for sharks and a Tier 5 for skates with the TAC set less than the combined other species

ABC. With sharks and skates broken out as their own category, the other species ABC and TAC would need to be recalculated to account for this.

- Additional impacts on spatial and temporal management of TAC by this measure could be the closure of many target fisheries when the shark and skate (and additional species in the case of FMP 3.2) TAC has been exceeded. There is currently no temporal nature to other species management however this may change by altering the species in the complex.

- Reducing PSC limits on herring, crab, halibut and salmon in the BSAI could impact the temporal nature of many fisheries. Fisheries which currently close seasonally due to exceeding seasonal caps, particularly the flatfish fisheries, would have even shorter seasons and possibly harvest less of their TACs with reduced PSC limits. However, under other measures in this alternative there are bycatch reduction incentive programs, increased rationalization and other means to harvest fish without exceeding this PSC cap regardless of whether or not it is reduced. It is possible, therefore, that this would not radically change the temporal nature of the fishery.

- In the GOA under policy Alternative 3, PSC limits for salmon, crab and herring are established (FMP 3.1) and then reduced (FMP 3.2). PSC limits for halibut are reduced under both example FMPs. Establishing crab, herring, and salmon PSC limits in the GOA fisheries could alter the temporal nature of these fisheries. Depending upon the amount of seasonal bycatch, some fisheries may have to rearrange their seasons and/or change the nature of their fishery to accommodate these caps. Some spatial management (area closures) may also be necessary as an in-season management measure in order to comply with PSC caps. Again, some closure areas will also be developed separately under this alternative; therefore, the cumulative impact of these closures would need to be considered in order to assess the importance on the spatial and temporal management of the fisheries. More information is in Appendix F-3, Essential Fish Habitat and Marine Protected Areas paper as well as Appendix F-5, Bycatch and Incidental Catch Restrictions paper.

6.0 Alternative 4: Adopt a Highly Precautionary Management Policy

Under this alternative, in the 4.1 bookend, TAC will be distributed spatially on smaller scales for all possible species except other species. The rationale for this alternative is that in the absence of scientific certainty that fishing is not causing an adverse impact, the burden of proof should be shifted such that it is assumed that it is causing an impact until evidence shows conclusively otherwise. Under this alternative, more precautionary measures are taken to mitigate for uncertainty in stock assessments and spatial allocative schemes. While no policy objectives specifically address spatial and temporal management, many of the objectives of managing on smaller spatial scales are covered under additional objectives.

Specific spatial and temporal management measures under the FMPs 4.1 and 4.2:

- FMP 4.1: Distribute TAC on smaller scales for all possible species. For analytical purposes, EBS pollock will be used as a proxy.

- FMP 4.2: TAC = 0, therefore, there is no spatial and temporal management of TAC for as long as the fisheries are closed.

6.1 Fishery Management Plan 4.1 Management Measures

Spatial and temporal management can be used as a tool to mitigate for the current limitations in both the stock assessment surveys and the models utilized. These limitations are associated with the degree of uncertainty in the stock structure in part due to seasonal rather than year-round surveys, and the degree of uncertainty in the spatial distribution of survey biomass. The objective is to disperse the fishery in both time and space to guard against localized depletion. Given the uncertainties regarding stock structure, a general concern is that concentrated fishing on a particular stock may result in the depletion of one segment of the stock population, as for example, when the fishery targets heavily on the spawning biomass.

Under this alternative, fishing effort would be proportional to the amount and distribution of biomass, provided this is consistent with essential fish habitat and other such mandates. Some problems with this approach, as discussed previously, are that it is very difficult to estimate the spatial and temporal distribution of stock biomass. Current surveys generally only cover limited timing within seasons. The difficulties of extrapolating between seasons for stock surveys (e.g., GOA pollock) where seasonal surveys exist, have already been highlighted in previous sections. However, under this alternative more precautionary management measures with respect to the spatial and temporal management of TAC will be taken using the best available scientific data until conclusive evidence shows that this is not necessary for managing these fisheries.

EBS pollock will be used as an example of a stock which could be managed on a smaller spatial and temporal scale. The NRC (1996) noted that spreading out the large pollock fishery in time and area may prove beneficial to predators. One potential mechanism for further dispersing the fishery in the absence of detailed information is to use measures proposed in the 1998 Biological Opinion. The 1998 Biological Opinion provides an example of how the EBS pollock could be dispersed on a finer spatial and temporal scale.

6.1.1 Spatial Measures

The spatial scales designated in this Biological Opinion for EBS pollock were the following three broad areas (based on available summer survey information):

1. critical habitat in the eastern Aleutian Islands (Sea Lion Conservation Area, “SCA”)
2. areas outside of critical habitat to the east of 170°W longitude
3. areas outside of critical habitat to the west of 170°W longitude

6.1.2 Temporal Measures

Two key objectives were recommended for temporal dispersion of the pollock fisheries (NMFS 1998). The first objective was for temporal dispersion to avoid removal during the winter period, and the second objective was to distribute the catch more evenly over the course of the year. The following criteria were also recommended, including a quarterly approach to allocation of the EBS pollock TAC (NMFS 1998):

1. continue prohibition of pollock fishing from November 1 to January 19 in the Bering Sea and GOA
2. distribute catch into at least four seasons, two from January to May, and two from June to October
3. limit combined TAC in winter/spring to a maximum of 45 percent
4. allocate single-season TACs to be no more than 30 percent of the annual TAC

5. prevent concentration of catch at the end of one season, beginning of the next
6. limit rollovers of unused TAC from one season to the next

In addition to these measures, in order to slow the pace of the fishery on a daily basis, a cap of 5,000 mt is proposed on daily catch rates. This 5,000 mt cap dates back to the average catch rates in these areas by the foreign fisheries in the period between 1982-1985 (Table 2*)*. During this period, the fishery was slower-paced and more widely dispersed outside of the current SCA, to the east and west of the 170°W longitude line in the EBS. (NMFS 1998).

One potential problem with these proposed measures is the ability of NOAA Fisheries to adequately enforce them. The 5,000 mt cap would be particularly difficult to enforce and could add an extreme burden to the inseason management staff. Impacts of these measures on target species are unknown but presumably these measures would be beneficial to the pollock population for which they are proposed, as well as to the endangered Stellar sea lion population.

Table 2. BSAI Pollock Specifications (mt) Recommended by NPFMC for 1999.

Area	1999 Biomass	1999 OFL	1999 ABC	1999 TAC	1998 TAC	1998 Catch
Eastern Bering Sea	7,040,000	1,720,000	992,000	992,000	1,110,000	1,020,720
Winter Seasons				40%	45%	
Summer/fall				60%	55%	
Aleutian Islands	106,000	31,700	23,800	2,000	23,800	21,945
Bogoslof	403,000	21,000	15,300	1,000	1,000	8

Source: NMFS, 1998 Table 2

6.2 Comparative Analysis of Alternatives

Spatial and temporal management of TAC is utilized as a tool in all of the alternatives, as illustrated by their associated FMPs. Under the current system, TAC is managed spatially and temporally as a tool to achieve various objectives, both biological and socioeconomic. Potential changes to the current management occur in FMPs 3.2 and 4.1. Under Alternatives 3 and 4, this current management would also include specifically conceiving of goals and objectives for managing TAC in space and time (FMP 3.2), a conceptual approach to manage all species on smaller spatial and temporal scales, regardless of the level of knowledge of the stock (FMP 3.2), and managing on a smaller spatial and temporal scale for conservation reasons utilizing a different approach (FMP 4.1). These alternatives all assume that management of TAC on smaller spatial and temporal scales would be beneficial to the target species.

The ability to effectively manage on smaller spatial and temporal scales is tied to the availability of stock biomass data. A discussion of better spatial and temporal management necessarily includes highlighting the need for additional information to effectively manage stock. These data gaps which have been previously

mentioned include better spatial and temporal information on individual stock migration, better identification to the species level of shortraker/rougheye rockfish, and more fine-scale, detailed information on the spatial and temporal distribution of every target species managed under these FMPs. The ability to effectively manage TACs on progressively smaller spatial and temporal scales necessitates the need for more information.

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